1,133,153

PATENT SPECIFICATION

DRAWINGS ATTACHED

1,133,153

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Int. Cl.:—B 42 b 5/08.

COMPLETE SPECIFICATION

Method and Apparatus for Binding Loose Sheets

We, Cartiere Paolo Pigna S.p.A., a joint stock company organised under the laws of Italy of 1, Via Daniele Pesenti, Alzano Lombardo, Province of Bergamo, Italy, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed to be particularly described in and by the following statement:

This invention relates to the binding of packets of perforated sheets to convert them into books which term where used herein generically includes all such bound packets whether they have covers or not.

More specifically, the invention is concerned with the conversion of packets of perforated sheets into books by means of wire binding elements of the kind sold under the Registered Trade Mark WIRE-O.

Such binding elements can be and generally are formed by bending out of a straight wire hair-pin shaped prongs at regular intervals along the length of the wire, to form a sort of comb and bending the prongs out of the plane in which they are formed to produce an article having the characteristics of a tube with a wide longitudinal open-ended slot in its wall. With the element in that condition—its half-closed condition—perforated sheets can be impaled on its prongs and when a sufficient number have been so impaled, the prongs can be bent further so as to close the above-mentioned slot, i.e. the element can be brought to its fully closed condition in which the sheets are securely bound.

Such elements are referred to in the claims attached hereto and elsewhere herein as "WIRE-O binding elements".

The invention is concerned with the binding operation proper, namely, the impaling of the sheets on the prongs with the binder element in the half-closed condition and the completion of the binding by bringing the binding element to its fully-closed condition.

In accordance with the invention, packets of perforated sheets are bound to book form by causing them to become impaled on the prongs of a WIRE-O binding element in its half closed position and then completing the closing of the element, the binding element being brought into the impaling position by being conveyed thereto in the direction of its length.

In the normal performance of the invention, a length of binder material of a length suitable for the production of a single book or a number of books is drawn from stock and fed to a station in which the prongs are caused to enter the perforations in the sheets, each packet to be bound is fed to a further station carrying a binder element with it, the prongs are caused to pass right through the perforations in the packet and the latter is brought to a further station where the half-closed binder element is closed.

It is not essential, however, that the prongs be caused to enter the perforations at the first station. It is sufficient that prongs and perforations be brought into registration with each other, the packets and the binder elements being, if necessary, conveyed to the next station by common or separate conveying means.

To cause the prongs to pass right through the perforations, the element can be turned about its axis and in the preferred form of the invention, this turning is caused to occur progressively along the length of the element as by causing the element to follow a helical path.

From the mechanical aspect, the invention includes within its scope a machine comprising means for conveying the binder material

[Price 4s. 6d.]

to an impaling station in the direction of its length, means for registering the binder prongs with the perforations in the sheets, means for impaling the sheets on the binder prongs by turning the binder about its longitudinal axis and closing the binder to complete the binding.

In the preferred form of the machine, the said registering means effect a partial impalement of the sheets on the prongs and the sheets provide the means for conveying the binder to the impaling station proper. Also, there are means for drawing the binder material from a stock as a continuous length and severing it to the length of the packet to be bound before the impaling is completed. For turning the binder about its longitudinal axis means are provided comprising a helical rib which as the packet and the binder element are fed along its length engages in the open side of the element to cause the latter to be turned progressively about its axis and the prongs in consequence to pass through the perforations in the sheets.

An example of a machine in accordance with the invention is shown in the accompanying drawings, in which:—

Figure 1 is a fragmentary perspective view of a book bound by the method and in the machine of the invention;

Figure 2 is a somewhat diagrammatic elevation of the machine;

Figure 3 is an enlarged view of a part of Figure 2, being an elevation partly in section taken in the direction of the arrow II in that Figure;

Figure 4 is a plan view of part of Figure 2 on a scale intermediate that of Figure 1 and that of Figure 3;

Figure 5 is a section taken on the line V-V in Figure 4;

Figure 6 is an enlarged view of a part shown in Figure 2;

Figures 7 and 8 are respectively an elevation and a plan of a wire cutting device shown in Figure 2;

Figure 9 is a diagram illustrating various stages in the binding of a book; and

Figure 10 illustrates a detail.

Figure 1 shows a typical packet of sheets 10 bound to form a book of a WIRE-O binding element 12. The latter is a continuous length of wire which at the start of the operation with which this invention is concerned is bent to the shape shown in the upper right hand corner of Figure 9. In that condition, the binding element is in the form of a channel and will be said herein to be in its half-closed position. As will be seen, the wire is bent to form prongs 14 separated from each other by aligned straight lengths of wire 16 which will be referred to as "spine members".

As shown here, the prongs of the binding element are kinked at 18 giving the element in cross-section the shape of a Greek . The purpose of this will be explained further on. Although a desirable feature, it is not an essential one.

At the end of the binding operation, as seen in Figure 1, the wire binding element has been converted from the half-closed channel condition to a fully closed tubular condition, the prongs 14 having been passed through perforations 20 in the sheets to be bound so that their outer ends become situated in the gaps between successive spine members 16 of the binding element.

Of course, the pitch of the prongs 16 and that of the perforations must match each other and the diameter of the binding element in its closed position governs the thickness of the packet of sheets which can be bound by the element. Various standards have become established in these connections and the back binder and his customer have available to them a range of binding element sizes expressed in terms of prong pitch and tube diameter. They can obtain the elements in cut lengths or as a continuous length from which they can draw and cut to their requirements.

The most generally adopted method of binding a WIRE-O bound book is the manual one. The operator is supplied with cut lengths of binder and packets of perforated sheets; she inserts the prongs in the perforations and, grasping the packet, presents its binding edge to a pedal operated press which closes the binder, i.e. converts it from the half-closed channel condition to the fully closed tube condition referred to above. The kink in the prongs referred to above ensures that the resulting tube is substantially cylindrical, the kink providing a pivot point for the two portions of the binding element on opposite sides of it which are substantially semi-circular in end view.

Operators, in time, acquire considerable digital dexterity but their output is well below what is desirable and the cost of manual mounting or binding is a substantial part of the total cost of the bound book.

Attempts have been made to mechanise the operation as in British Patent No. 987,116 which provides a useful saving in manufacturing cost but which leaves room for considerable improvement.

The present invention, simply stated, is the application of the idea that for simplicity of construction and operation of a high output mounting or binding machine, the binder material which, in the course of its manufacture is continuously formed in the direction of its length, must pass into and through the machine in the direction of its length and not transversely thereto as in a machine built on the principle of the above-mentioned British Patent.

The binder material can be fed continuously or intermittently to the machine as a continuous length and be severed to the desired length at any one of a number of stages in the course of the binding operation or as pre-cut lengths but in each of these cases, the binder material passes through the machine longitudinally.

In the machine shown in the drawings, a stock of binder element 12 in the half-closed condition is stored on a drum 22, driven by a motor 24. The binder passes over a smooth saddle 26 beyond which it is engaged by a feed sprocket 28. Upstream of the saddle, the binder hangs in a bight passing between the prongs of a fork 30 shown diagrammatically to represent conventional control means for varying or stopping and starting the motor 24 to ensure that the delivery from the drum 22 is cynchronised with that determined by the sprocket 28 so that the binder is fed to that sprocket in a substantially untensioned condition.

After passing over the saddle, the binder material is received by a curved guide rod 32 having in it a longitudinal groove 34. As can be seen from the drawings (Figures 2, 3, 4, 5), the binder straddles the guide rod with its kinked back spanning the groove 34. The sprocket 28 is driven by a motor 36 (shown diagrammatically) through gearing 38 and a shaft 40. Its diameter and the pitch of its teeth are chosen so that the prongs 14 are received between the latter which penetrate the groove 34 and the binder is fed into the machine without being stretched.

The packets of sheets 10 to be bound into books are conveyed into and through the machine by a conveyor comprising a pair of chains 42 provided at regular intervals determined by the length of the books with pushers 44. The conveyor is driven continuously from right to left of Figures 1-4 by means not shown.

Each packet is conveyed beneath a photo-electric cell 46 which senses the leading edge of the packet and prepares a starting circuit for the motor 36. Alongside the cell 46, there is a contact 48 (shown diagrammatically) which is set forward of the cell (to the left in Figure 4) by an amount corresponding to the distance x (Figure 1) between the leading edge of the packet and the centre of the first perforation. The contact 48 is made by the leading edge and when that happens a circuit is closed for the motor 36 which then drives the sprocket 28 and consequently the binder is drawn from the drum 22. The contact 48 remains closed until released by the trailing edge of the packet of sheets whereupon it opens the motor circuit and the feed of binder material ceases. The electrical connections have not been shown but merely indicated by the chain line 50 in Figure 4 as these are conventional.

In this way, the packet of sheets to be bound and the binding material are fed through the machine in synchronism and in register with each other, that is to say, with the prongs 14 of the binder opposite the perforations in the book. It is recalled that the packet moves continuously while the binder material remains at rest between the instant at which the trailing edge of one packet passes the contact 48 and the leading edge of the next packet reaches that contact.

On the shaft 40 which drives the sprocket 28, there is a bevel gear 52 driving a bevel gear 54 on a shaft 56 on which is mounted a sprocket 58. The latter, which is at right angles to the sprocket 28 engages the side of the binding material on the guide rod 32 as shown in Figures 7 and 8 and assists in driving it through the machine. The under side of the sprocket 58 is reduced in diameter and carries a knife 60 which periodically severs from the continuous length of binder material being fed from the drum, a length equal to or a little shorter than that of the packet of sheets to be bound. As seen in Figure 8, the side of the guide rod 32 is recessed at 62, the base of recess providing an abutment for the wire binder material which is severed across one of its spine members 16.

The severed length is fed forward by the sprockets 28 and 58 in register with the packet to be bound but provision has to be made for its further conveyance through the machine when it moves out of the influence of those sprockets.

Consequently the top surface of the guide rod 32, which continues past the said sprockets, is sloped downwards as shown clearly in Figure 3 and there is provided above it an endless belt 64 the drive for which is shown at 66 in Figure 4. The packet is supported so that its perforations, when longitudinal synchronism has been achieved, are directly below the prongs of the binding material on the guide rod 32. Therefore, when that material comes under the influence of the belt 64, the prongs are caused to penetrate a short distance into the perforations. Thereupon, the severed length of binder is carried forward with and by the packet to be bound.

This state of affairs is depicted in the diagram of Figure 9. Therein, at the extreme right is seen the binder material entering the machine, being driven by the sprockets 28 and 58, with its prongs directed downwards. In due course, a length is severed from it by the knife 60 but before that occurs, it comes under the influence of the belt 64 which, because of the downwardly sloping top face of the guide rod 32, presses the binder down from the position shown at A to the position shown at B where the prongs 14 have entered the perforations 20.

The binding edge of the packet of sheets then enters a tunnel 66 closed at the top (Figures 2, 6 and 9) by a cover 68. The rear face of the tunnel is slotted as seen in Figure 6 to allow the binding edge of the packet of sheets to be engaged in it. (For the sake of clarity, the tunnel has been shown with its slotted face forward, that is to say, as seen from the back of the machine). In considering that Figure, therefore, the packet and its binding element must be assumed to be travelling from left to right. In operation, the cover 68 is, of course, closed.

Within the tunnel there is a rib 70 which proceeds as a slow pitch helix throughout the length of the tunnel the object of which is to cause the binding element to be progressively turned on its longitudinal axis until its open side becomes vertical instead of horizontal as indicated at each end of the tunnel in Figure 6 and at C in Figure 9.

When the tunnel is reached, the binding element is still on the guide rod 32 but is then transferred therefrom on to a lead-in member 72 and thence on to the rib 70.

As will be seen at C in Figure 9, one side of the rib 70 is cut away at 74 so that, under the action of gravity, the sheets slide on each other to give a degree of obliquity to the passage 76 formed by the perforations in them. This enables the size of the perforations measured at right angles to the binding edge to be kept reasonably small while allowing free passage for the prongs 14.

The book finally emerges from the tunnel with its binding element engaged over the edge of a dovetailed horizontal rib 78 as shown at D in Figure 9. Here, the spine members 16 are in contact with the upper face of the rib 78 so that the latter hold the element against twisting while the remainder of the element is still engaged on the helical rib 70.

Finally, the packet is conveyed off the rib 78 into a closing station E (Figures 2 and 9). Therein there is a press having a movable upper jaw 80 (Figure 9) which is brought down at the right moment on to the binding element (disposed relatively to the packet of sheets as shown at D in Figure 9) so as to bring it to cylindrical or tubular shape.

The closing press is operated automatically as indicated in Figure 10. As will be seen, there is a contact 82 which lies in the path of the packet pushers 44. When the contact is raised it establishes a circuit for a solenoid 83 the operation of which results in the clutching of a plate 84 to a plate 86 permanently rotated by a motor 90. A shaft 88 is thus driven and actuates the movable jaw of the press. At the end of one revolution, the clutch 84, 86 is opened. Any other form of one revolution clutch can be used.

It will be seen that the whole binding operation has been effected mechanically without changing the direction of movement of the binding material which travels always in the direction of its length. This leads to high production and also to simplicity of construction of the machine.

As already indicated, the machine may, if desired, be fed with binder elements pre-cut to the required length. Where the severing is effected automatically in the machine, this may be done at one of a number of stages, for example, immediately after the initial engagement of the binder prongs in the perforations in the sheets to be bound or immediately before the packets enter the tunnel 66. Nor is it essential that the prongs be engaged in the perforations before the tunnel is reached. In that case, however, means must be provided for conveying the binder element when it comes out of the influence of the sprockets 28 and 58. These means can consist for example of a further sprocket or sprockets or a belt or chain conveyor.

The helical rib which progressively turns the binder element through 90° is the applicants' preferred device but is not an essential element of the invention. It could be replaced by means engaging the spine members of the element to turn the latter through 90° not progressively along its length but simultaneously at all points in its length. Such means can be mechanical or electromagnetic.

The machine shown in the drawings and described herein has to be set up to suit a binding element of a particular size—as to pitch of prongs, closed diameter and length. It therefore finds its greatest utility when it is a question of very long runs as, for example, as part of a paper conversion installation turning out articles of stationery. It is, however, a relatively simple matter to exchange parts suitable for one size of binder to parts suitable for another.

Various safety means can be incorporated such, in particular, as a thickness gauge to prevent overthick packages being conveyed through machine as, for example, in the case of one packet becoming lodged on top of another.

WHAT WE CLAIM IS:—

1. A method of binding packets of perforated sheets with WIRE-O binding elements (as herein defined) comprising causing the sheets to become impaled on the prongs of the elements with the latter in the half closed condition and then completing the closing of the elements, in which the binding elements are brought into the impaling position by being conveyed thereto in the direction of their length.

2. A method as claimed in claim 1 in

which the binder material is drawn from stock and fed to a station in which the prongs are caused to enter the perforations in the sheets, the packets to be bound are fed to a further station carrying the binder elements with them, the prongs are caused to pass right through the packets of sheets and the latter are then brought to a further station where the half closed binder elements are completely closed.

3. A method as claimed in claim 1 in which the perforations in the sheets forming a packet and the prongs of a binder element are brought into registration with each other and conveyed together to a station at which the element is turned about its axis to cause the prongs to pass through the perforations.

4. A method according to claim 3 in which the turning of the binder element about its axis is performed progressively along the length of the element.

5. A method according to claim 4 in which the turning is effected by causing the element to follow a helical path.

6. A machine for binding packets of perforated sheets with WIRE-O binding elements (as herein defined) comprising means for conveying binder material to an impaling station in the direction of its length, means for registering the binder prongs with the perforations in the sheets, means for impaling the sheets on the binder prongs by turning the binder about its longitudinal axis and closing the binder to complete the binding.

7. A machine as claimed in claim 6 in which the said registering means effect a partial impalement of the sheets on the prongs and the sheets provide the means for conveying the binder to the impaling station proper.

8. A machine as claimed in claim 7 comprising means for drawing the binder material from stock as a continuous length and severing it to the length of the packet to be bound before the impaling is completed.

9. A machine as claimed in claim 6 comprising at the impaling station a helical rib, means for conveying the packet of sheets and the binder element registered therewith in the axial direction with the rib engaged in the open side of the element whereby to cause the binder element to be turned progressively about its axis and pass through the perforations in the sheets.

10. A method of converting packets of perforated sheets into books substantially as desoribed herein.

11. A machine for converting packets of perforated sheets into books substantially as described with reference to the accompanying drawings.

For the Applicants,
LLOYD WISE, BOULY & HAIG,
Chartered Patent Agents,
Norman House, 105-109, Strand,
London, W.C.2.

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Fig. 7.

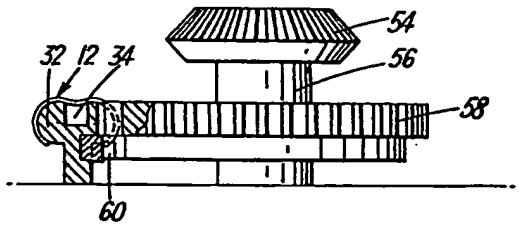
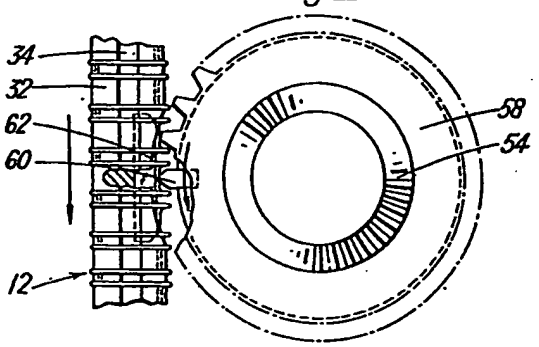
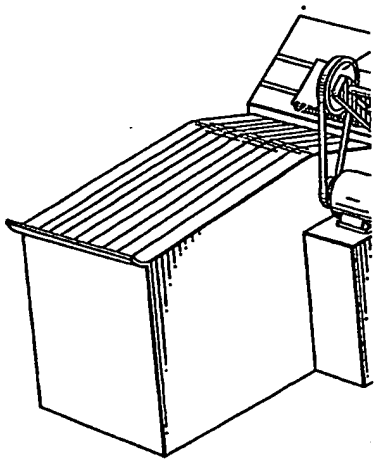


Fig. 8.





1,133,153 COMPLETE SPECIFICATION
4 SHEETS

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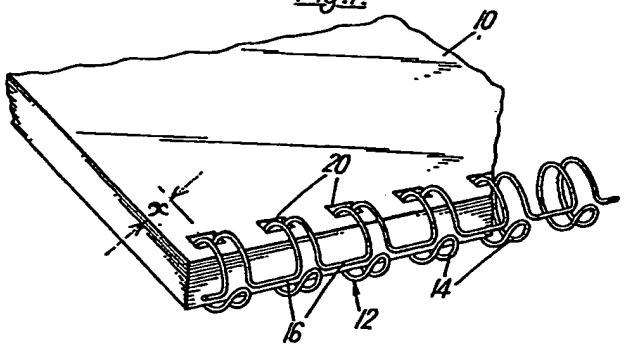
SHEET 1

Fig.1.



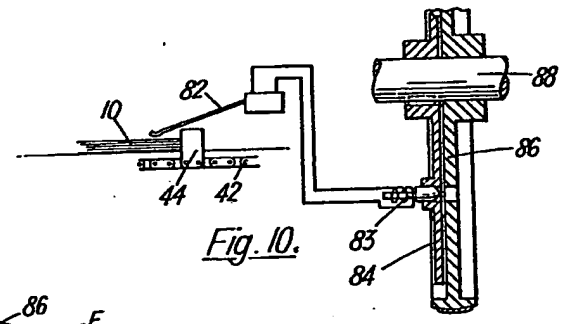


Fig.10.

Fig.2.

1,133,153 COMPLETE SPECIFICATION
4 SHEETS

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SHEET 1

Fig.7.

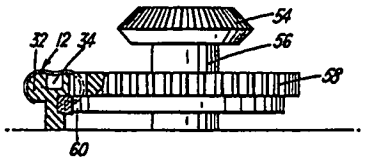


Fig.8.

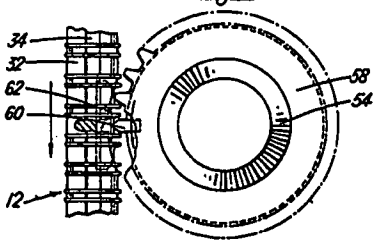
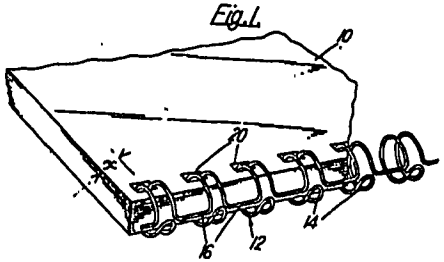


Fig.1.



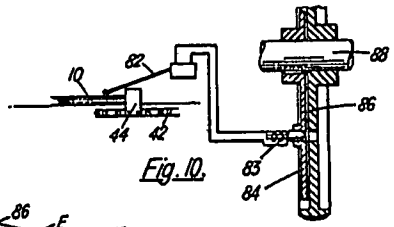


Fig.10.

Fig.2.

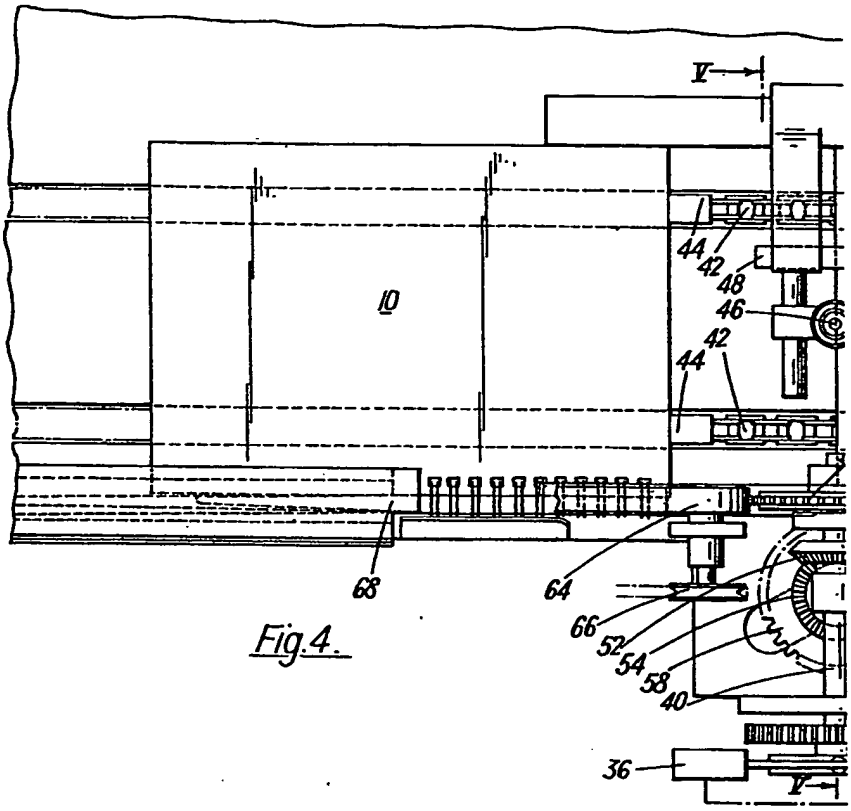
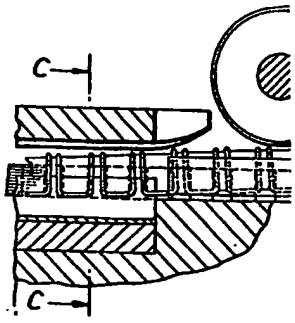


Fig.4.



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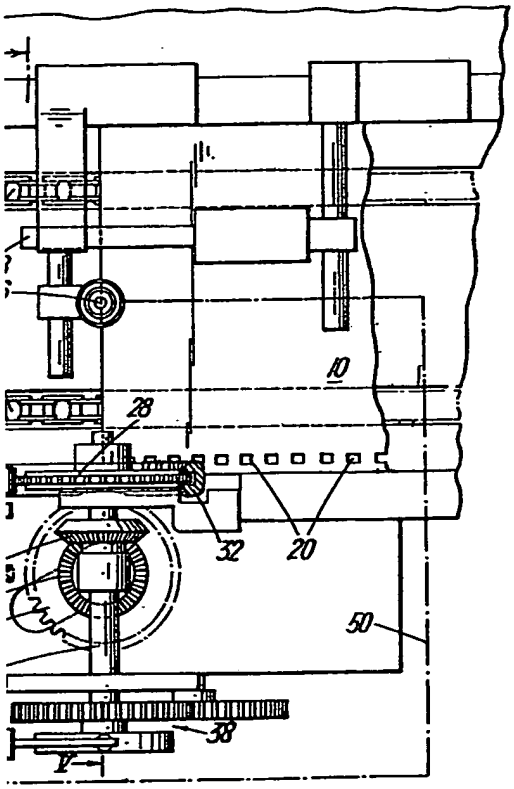
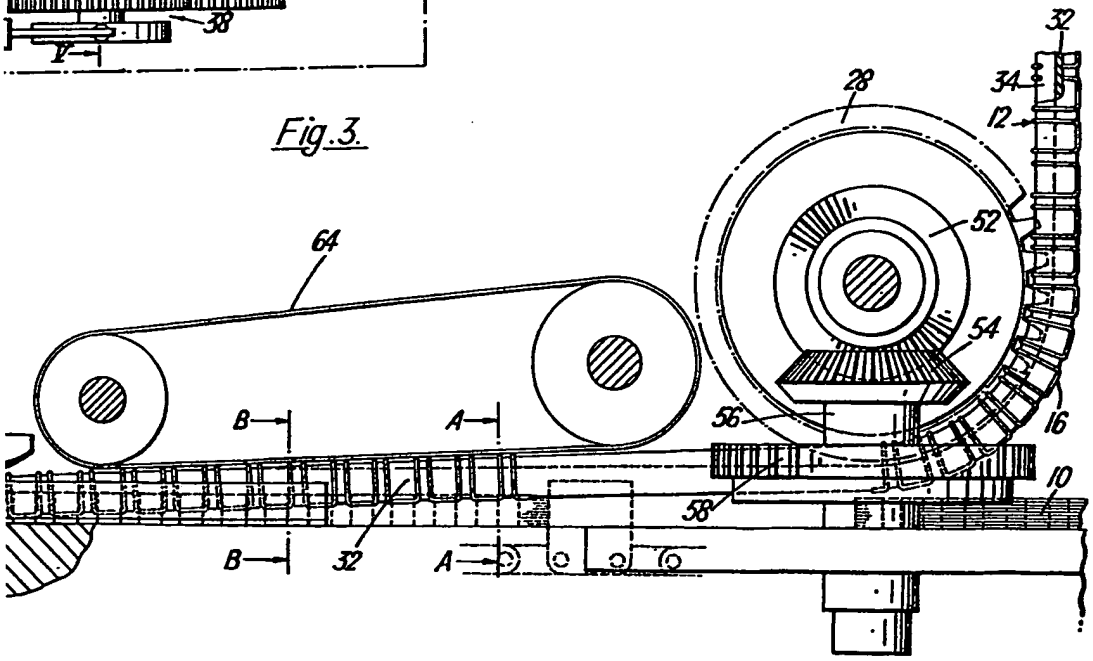


Fig.3.



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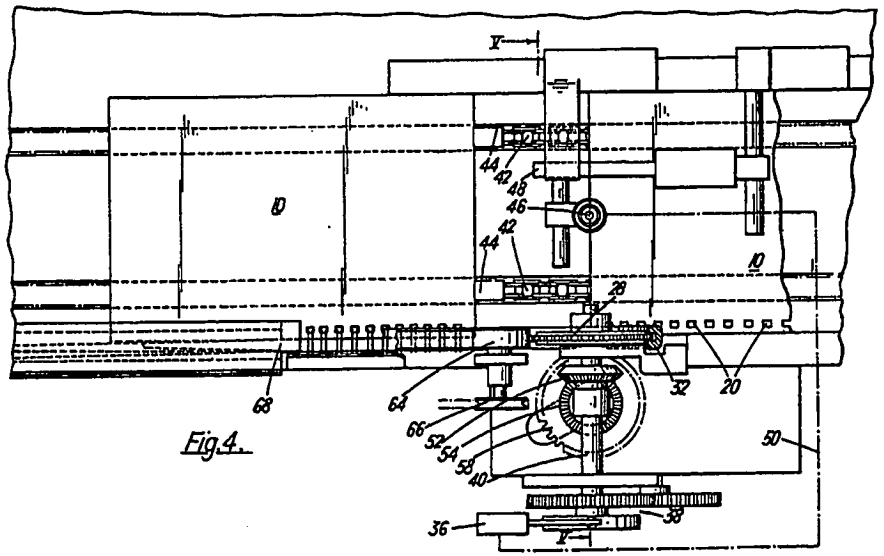

Fig.4.

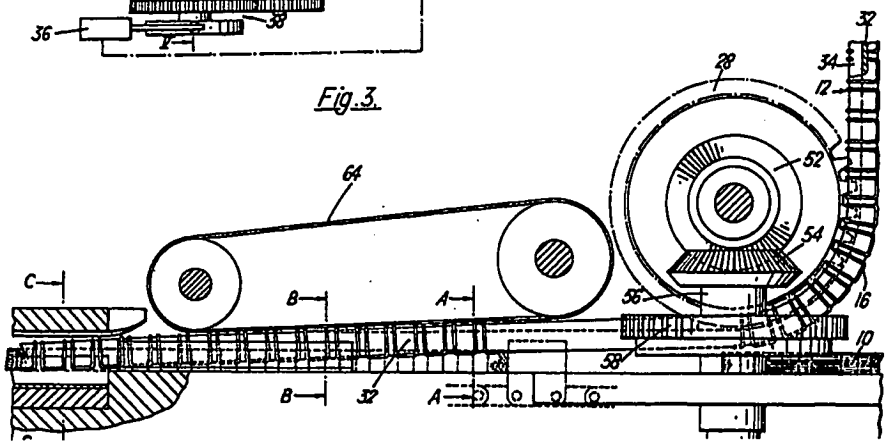

Fig.3.

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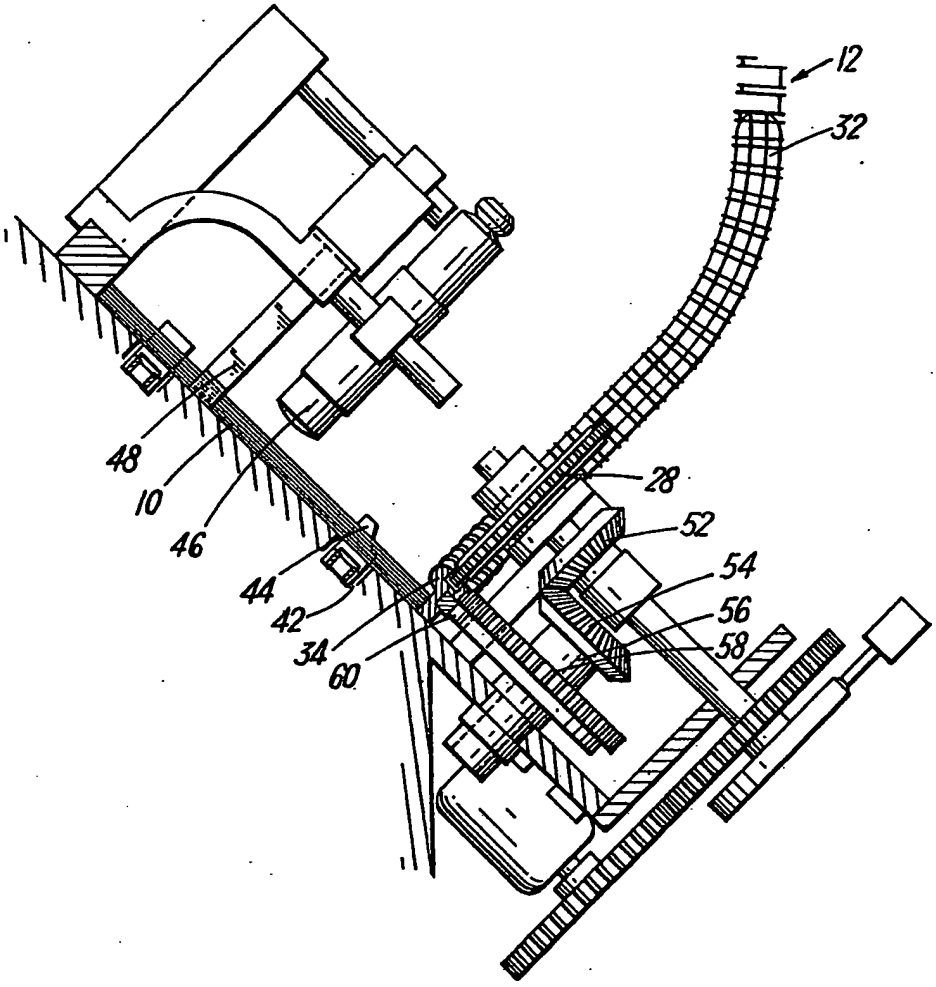

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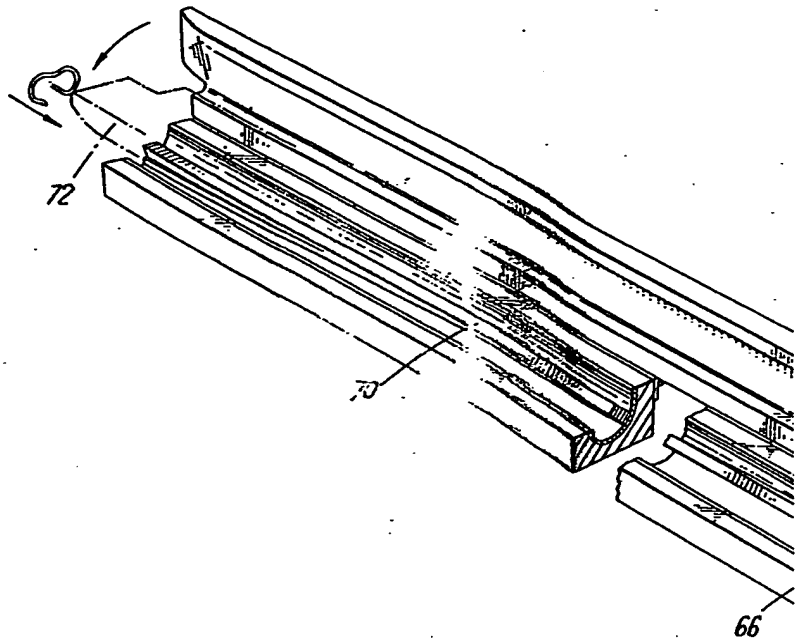
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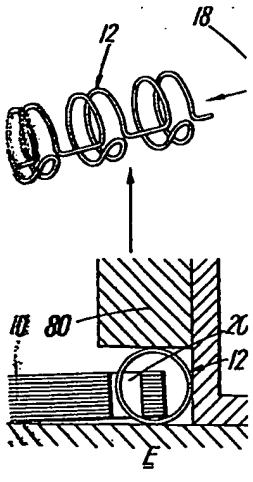
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1,133,153 COMPLETE SPECIFICATION
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SHEET 4

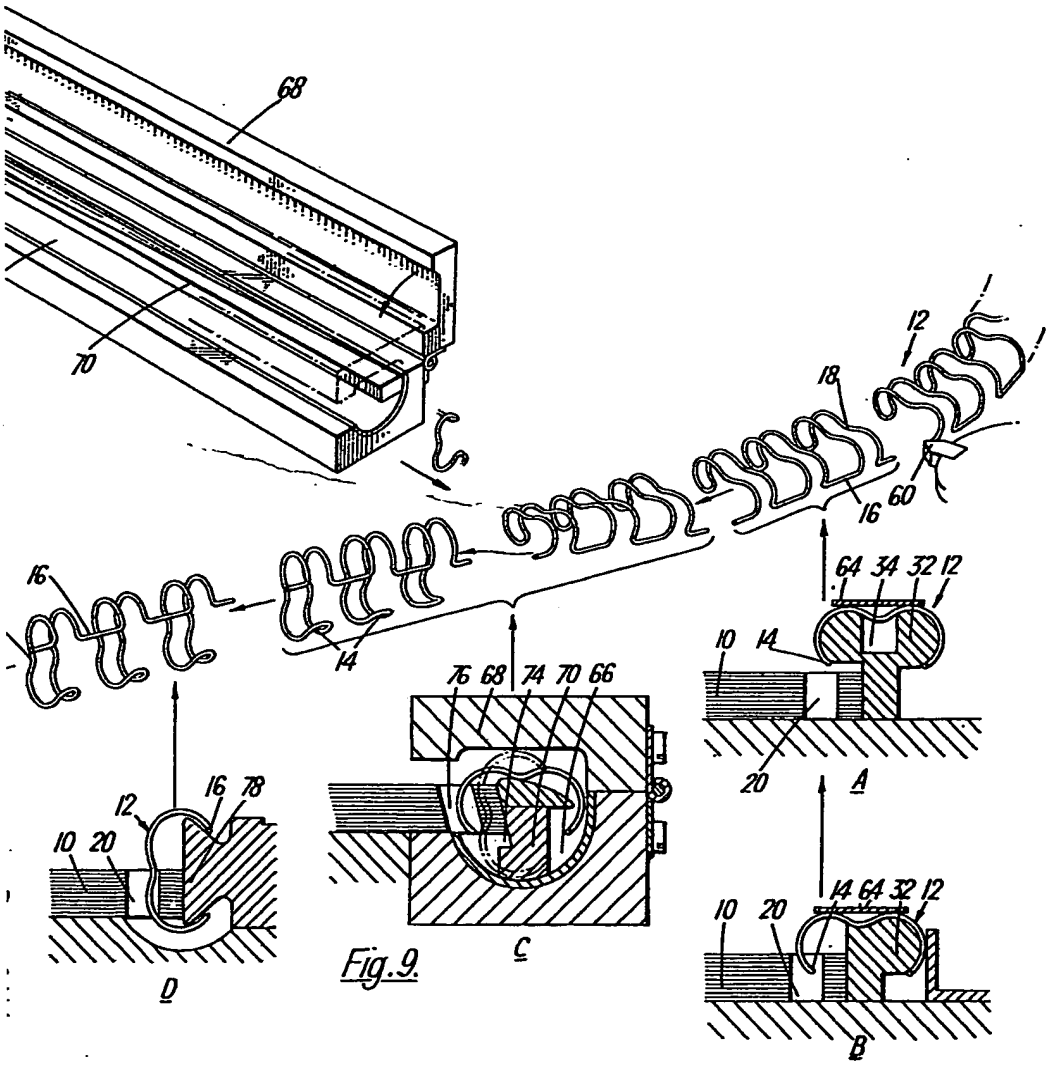

Fig. 9.

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SHEET 4

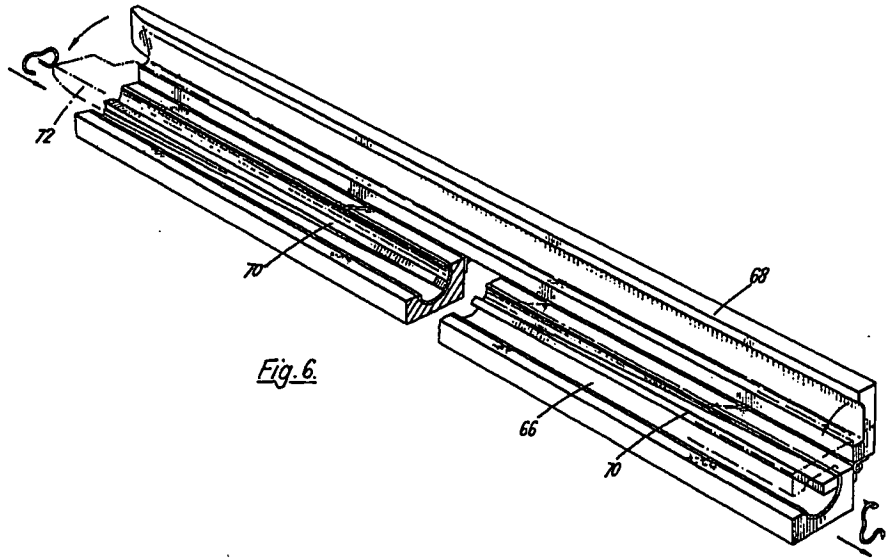

Fig. 6.

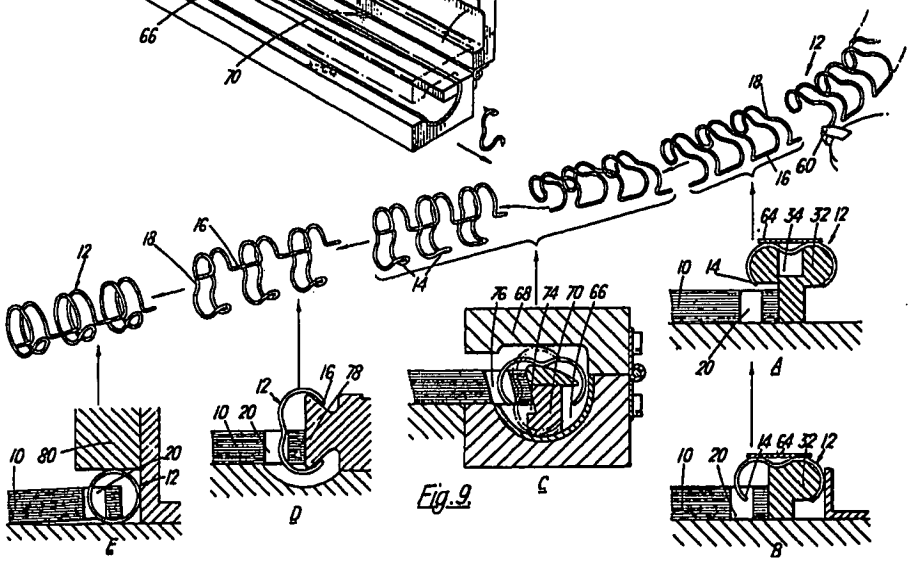

Fig. 9